Name: ____ Date: ____

Polynomial Operations SOLUTION (version 232)

1. Let polynomials $p(x)$ and $q(x)$ be defined below.

$$p(x) = 8x^5 - 9x^4 - 6x^3 - 4x^2 - 1$$

$$q(x) = x^5 + 6x^4 - 9x^3 - 3x + 7$$

Express the sum of $p(x) + q(x)$ in standard form.

Get "unsimplified" forms. Then find $p(x) + q(x)$ with addition/subtraction.

$$\begin{aligned} p(x) &= (8)x^5 + (-9)x^4 + (-6)x^3 + (-4)x^2 + (0)x^1 + (-1)x^0 \\ q(x) &= (1)x^5 + (6)x^4 + (-9)x^3 + (0)x^2 + (-3)x^1 + (7)x^0 \\ p(x) + q(x) &= (9)x^5 + (-3)x^4 + (-15)x^3 + (-4)x^2 + (-3)x^1 + (6)x^0 \\ p(x) + q(x) &= 9x^5 - 3x^4 - 15x^3 - 4x^2 - 3x + 6 \end{aligned}$$

2. Let polynomials $a(x)$ and $b(x)$ be defined below.

$$a(x) = 4x^2 - 2x - 9$$

$$b(x) = 4x + 5$$

Express the product $a(x) \cdot b(x)$ in standard form.

You can use a table for multiplication.

*	$4x^2$	$-2x$	-9
$4x$	$16x^3$	$-8x^2$	$-36x$
5	$20x^2$	$-10x$	-45

$$a(x) \cdot b(x) = 16x^3 - 8x^2 + 20x^2 - 36x - 10x - 45$$

Combine like terms.

$$a(x) \cdot b(x) = 16x^3 + 12x^2 - 46x - 45$$

3. Express $(x+1)^6$ in standard (expanded) form.

Remember the binomial theorem. It tells us to use Pascal's triangle.

$$x^6 + 6x^5 + 15x^4 + 20x^3 + 15x^2 + 6x + 1$$

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4. Let polynomials $f(x)$ and $g(x)$ be defined below.

$$\begin{aligned} f(x) &= 3x^3 + 25x^2 + 6x - 15 \\ g(x) &= x + 8 \end{aligned}$$

The quotient of $\frac{f(x)}{g(x)}$ can be expressed as a polynomial, $h(x)$, and a remainder, R (a real number).

$$\frac{f(x)}{g(x)} = h(x) + \frac{R}{x+8}$$

By using synthetic division or long division, express $h(x)$ in standard form, and find the remainder R.

I prefer using synthetic division.

$$\begin{array}{r|rrrr} & 3 & 25 & 6 & -15 \\ -8 & & -24 & -8 & 16 \\ \hline & 3 & 1 & -2 & 1 \end{array}$$

So,

$$\frac{f(x)}{g(x)} = 3x^2 + x - 2 + \frac{1}{x+8}$$

In other words, $h(x) = 3x^2 + x - 2$ and the remainder is $R = 1$.

5. Let polynomial $f(x)$ still be defined as $f(x) = 3x^3 + 25x^2 + 6x - 15$. Evaluate $f(-8)$.

You could do this the hard way.

$$\begin{aligned} f(-8) &= (3)\cdot(-8)^3 \;+\; (25)\cdot(-8)^2 \;+\; (6)\cdot(-8) \;+\; (-15) \\ &= (3)\cdot(-512) \;+\; (25)\cdot(64) \;+\; (6)\cdot(-8) \;+\; (-15) \\ &= (-1536) \;+\; (1600) \;+\; (-48) \;+\; (-15) \\ &= 1 \end{aligned}$$

Or, if you reference the polynomial remainder theorem, you can state that you know $f(-8)$ equals the remainder when $f(x)$ is divided by $x+8$. Thus, $f(-8) = 1$.